UDC 666.3.022

KAOLIN-CONTAINING PRODUCTS FROM THE ZHURAVLINYI LOG DEPOSIT

T. M. Argynbaev[1] and Z. V. Stafeeva[1]

Translated from *Steklo i Keramika*, No. 1, pp. 30 – 31, January, 2009.

Enriched kaolin from the Zuravlinyi Log deposit is finding wide application in the production of various ceramic articles. "Plast-Rifei" JSC is using this kaolin as a base for producing chamotte suitable for the production of sanitary-technical wares and other articles, including ones with large and complex shapes.

There are 25 kaolin deposits with a total reserve inventory of categories A + B + C_1 282,678 thousand metric tons and category C_2 135,412 thousand metric tons, including five deposits in the Russian Federation. There are five kaolin deposits in Chelyabinsk oblast'. Kaolins from Chelyabinsk and Orsk Trans-Urals region are part of the Urals-Mugodzharskoe kaolin-bearing province, the largest province in Russia with respect to reserves and the number of explored and operating deposits. In 2003 – 2006 surveys and assays were made on an extensive area near the town of Orsk in Orenburg oblast'. An in-depth study of the South-Ushkotin deposit has just now begun. The most promising region with respect to kaolin deposits in Chelyabinsk oblast' is the Plast region. A survey identified five sites with kaolin deposit which merit attention: Zhuravlinyi Log, Stafeevskoe, Kotlinskoe, Plastovskoe, and Chuksinskoe, of which the first three of greatest interest. The total reserves (category R_2) are of the order of 60×10^6 tons.

In the Russian Federation, at the present time, only primary (eluvial) kaolins are extracted and then enriched. The actual active reserves of eluvial kaolins are concentration in Chelyabinsk oblast' (Fig. 1). This is the Kyshtymskoe deposit, which forms the base for enrichment by the wet method — "ATEKS" JSC (20.1 thousand tons/year); in Kartalino region there is the Eleninskoe deposit — "Novokaloinovyi GOK" JSC (56 thousand tons/year); the deposit Zhuravlinyi Log — "Plast-Rifei" JSC (60.5 thousand tons/year); Poletaevskoe deposit, which has been actively worked for the last three years with raw kaolin being extracted. Of the 900 thousand t of kaolin produced in 2007 in Russia, 600 thousand tons came from Chelyabinsk oblast'.

A detailed survey of the Zhuravlinyi Log was completed in 2007. After the reserves were verified, the State Committee on Reserves accepted in the government inventory 17×10^6 tons raw kaolin in the dry state; this is 24.3×10^6 tons in the natural state. Five deposits with less than 1.1%[2] auxiliary content of iron oxide were identified and delineated on this field. The most promising one is the Tsentral'noe (Central) deposit, which is being worked at the present time. There are plans to start working the North-East (marble) deposit in the near future.

A great deal of work has been done on studying the quantitative composition and qualitative characteristics of the kaolins in the deposit. Three basic natural types of kaolin are present. Kaolins formed by erosion of granites in the Povarnen mountain range dominate. The kaolins developed along the surrounding rocks-gneisses and crystalline schist differ macroscopically and according to the chemical composition. In turn, kaolins along the boundaries are found in two

[1] "Plast-Rifei" JSC, Plast, Chelyabinsk oblast', Russia.

[2] Here and below — content by weight.

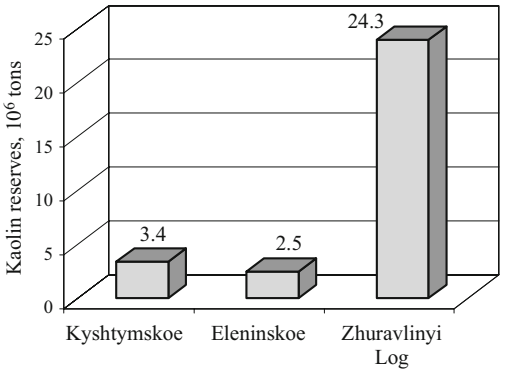

Fig. 1. Reserves present in the kaolin deposits in Russia, which are the basis for the operation of enrichment works.

forms — normal and alkaline, differing by the content of potassium oxide (Fig. 2).

The kaolins formed in granites are of greatest interest. The enriched products obtained from the raw gneiss kaolins have only limited use, since they characteristically have a high content of titanium and iron oxide colorants. The kaolins with iron oxide content up to 1.1% were included in the reserve inventory. For this reason, the kaolins in the surrounding rock were classified as unconditioned.

The efforts of a number of teams were presented for consideration to the Government Committee on Reserves. The Kazan' Central Scientific – Research Institute of the Geology of Nonmetalliferous Minerals investigated the material composition of the kaolins. The technological properties of the kaolin-containing products, obtained during commercial prototype tests were studied in divisional institutes for the production of paper and rubber-technical articles as well as in ceramic and porcelain works in Russia. In-office studies of the geological data were performed by the Moscow Geological Group INOPROM. The technological properties of all domestic types of kaolins presented in the deposits are exhaustively reported in geological surveys of the deposits. The geological survey data will make it possible in the future to work the deposits in accordance with the needs of the existing kaolin market.

In order to use natural resources in a rational manner, a technology for classifying kaolin-containing raw materials which permits obtaining two basic products — enriched kaolin and premix (a mixture of kaolin, sand, and alkali-containing minerals) — has been proposed and adopted.

There was enough information on the kaolin concentrate. We wish now to discuss new products.

The main purpose of the premix is to use kaolin parts, specifically, ceramic-granite, in production. The kaolin-containing product (premix) consists of two main components — kaolin and quartz; it also contains 8 – 10% alkali-containing and mixed-layered minerals.

The first experimental-commercial batches were obtained in ceramic works producing ceramic-granite and brick. Premix-based ceramic tiles exhibit a light color hue. This is because the content of coloring oxides in kaolin and quartz sands contained in premix is negligible.

The chemical composition of premix is as follows (%): 19.5 – 21.0 Al_2O_3, 69.5 – 71 SiO_2, 0.4 – 0.6 Fe_2O_3, 0.2 – 0.3 TiO_2, 0.8 – 1.0 K_2O, 0.1 Na_2O, 0.1 CaO, 6.8 – 7.2 other impurities.

The stability of the granulometric composition, specifically, the limited presence of large quartz inclusions larger than 2.5 mm (in the range 0.5 – 1.2%) makes the material attractive for milling in continuous mills.

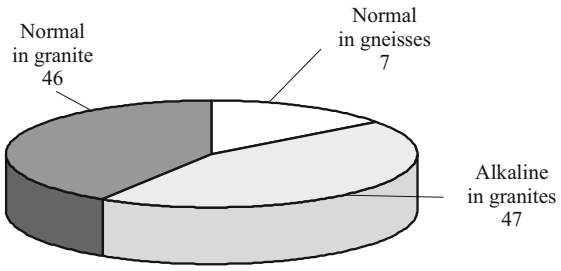

Fig. 2. Ratio of the natural types of kaolins in the Zhuravlinyi Log deposit (%).

Finally, a nontrivial factor is the price of the product, which permits improving the cost-effectiveness of the production of ceramic tiles by using the enriched kaolin product indicated above in the ceramic paste. The only negative factor which was observed in the first tests is elevated dustiness. This was eliminated by slightly moistening the product, adding up to 8 – 9% water.

In 2007 – 2008, the Italian company S.R.C. Engineering S.r.l. and "Plast-Rifei" performed joint investigations on the production of a new (for the Russian market) product — chamotte based on enriched kaolin from the Zhuravlinyi Log deposit. The mineral composition is (%): 69 mullite, 16 glass phase, 12 cristobalite, 4 quartz. The chemical composition is (%): 41.0 – 42.9 Al_2O_3, 52.1 – 53.5 SiO_2, 0.9 – 1.2 Fe_2O_3, 0.5 – 0.7 TiO_2, 0.8 – 1.1 K_2O.

A technology for producing mullite that is suitable for producing sanitary ware with large dimensions or with a special design has been developed. The first commercial batches of chamotte based on kaolin from the Zhuravlinyi Log deposit were obtained using the equipment manufactured by "Stroikeramika" (Yuzhnoural'sk). The chamotte has been tested under industrial conditions at the "Kerasan" works (Italy) as well as in a number of ceramic enterprises in Russia. This chamotte greatly improved the whiteness of the articles; there were difficulties in finding the correct mixture of engobe and glaze. The articles made of chamotte faience mixes are characterized by low shrinkage (4 – 6%) and negligible deformation during drying and calcination, so that it is possible to manufacture ceramic particles with a complex design, the market demand for which is increasing.

In summary, today, the Zhuravlinyi Log kaolin deposit is the largest kaolin deposit in the Russian Federation that has been completely surveyed and assayed by the government. The existing enrichment capacities make it possible to organize the production of different kaolin-containing products for use as a raw material in the production of ceramics in Russia.